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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/619,922

07/15/2003

Bing Ji

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EXAMINER

GEORGE, PATRICIA ANN

ART UNIT

PAPER NUMBER

1792

MAIL DATE

DELIVERY MODE

01/24/2008

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/619,922

Applicant(s)

JI ET AL.

Examiner

Patricia A. George

Art Unit

1792

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 20 November 2007.
- 2a) ☒ This action is FINAL. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-10, 17, 20 and 27-29 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-10, 17, 20, 27-29 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- ☒ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☐ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____
- ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- ☐ Notice of Informal Patent Application
- ☐ Other: _____

DETAILED ACTION

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1, 3, 5, 6, 8, 17, and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shibata et al. (2003/0079757 A1) and Mori (2000-063826).

Shibata teach a fluorinated cleaning gas that contains a fluorocompounds such as CF₃OF (same as fluoroxytrifluoromethane) and perfluorocarbons such as CF₄, C₂F₂, C₄F₁₀, and C₅F₁₂, which can be used individually or in combination. Another gas such as He, Ne, Ar, or O₂ can be mixed with the fluorinated cleaning gas [0078-0088]. The aforementioned reads on: a mixture comprising: a fluorocarbon; and a fluorine-containing oxidizer selected from the group consisting of fluoroxytrifluoromethane, bis-trifluoromethyl-trioxide, fluoro-trifluoromethyl-trioxide, fluoroformyl trifluoromethyl-trioxide, and combinations thereof, **in claim 1**; wherein the inert diluent gas is at least one selected from the group consisting of argon, neon, xenon, helium, nitrogen, krypton, and combinations thereof, **in claim 3**; wherein the fluorocarbon is at least one selected

from the group consisting of perfluorocarbon, hydrofluorocarbon, oxyhydrofluorocarbon, oxyfluorocarbon, and combinations thereof, **in claim 5**; wherein the fluorocarbon is at least one perfluorocarbon selected from the group consisting of tetrafluoromethane, trifluoromethane, octafluorocyclobutane, octafluorocyclopentene, hexafluoro-1,3-butadiene, and combinations, **in claim 6**; wherein the fluorocarbon is at least one hydrofluorocarbon, **in claim 8**; and wherein the dielectric material is at least one selected from the group consisting of silicon, silicon-containing compositions, silicon dioxide, undoped silicon glass, doped silica glass, silicon and nitrogen containing materials, organosilicate glass, organofluoro-silicate glass, low dielectric constant materials, polymeric materials, porous low dielectric constant materials, and combinations thereof, **in claim 17**.

Shibata differs in failing to teach a mixture for etching a dielectric material in a layered substrate, **in claim 1**; and a mixture for etching a dielectric material in a layered substrate comprising: a fluorocarbon and a fluorotrioxide, **in claim 20**.

Since Shibata discloses similar gases as those of the claimed invention, then using Shibata's gases in the same manner as claimed by Applicants would result the same in a mixture for etching a dielectric material in a layered substrate comprising: a fluorocarbon and a fluorotrioxide.

Absent unexpected results, it would have been obvious to one having ordinary skill in the art at the time the invention was made to employ any combination of etchant components as taught in the reference of Shibata including Applicants' specifically claimed etchant mixture because such combination of etchant mixture is known to

effectively accomplish the disclosed composition in manufacturing semiconductor devices [0001].

Shibata further differs in failing to teach wherein a ratio by volume of the fluorine-containing oxidizer to the fluorocarbon is from 0.1:1 to 20:1; 0.1:1 to 10:1; and 0.1:1 to 5:1, respectively in **claims 1, 28, and 29**, however, Shibata illustrates the specific combination of a fluorocarbon and fluorine-containing oxidizer is known to be effective.

Absent unexpected results, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select any proportion (% by volume) fluorocarbon in the Shibata reference because such combination is known to effectively accomplish the disclosed composition by using a small amount of gas to efficiently remove by-products such as SiO_2 and Si_3N_4 [0021].

Claim Rejections - 35 USC § 103

Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Shibata (US '757 A1) as applied to claims 1, 3, 5, 6, 8, 17, and 20 above, and further in view of Arleo et al. (US 5,176,790).

Shibata differs in failing to teach and wherein the mixture comprises from 0.1 to 99 % by volume of the inert diluent gas.

Arleo teaches etching mixtures comprising inert gases such as helium, neon, argon, krypton or xenon (column 3, lines 53-55) and may vary from 0 to 90 volume % of the total amount of gases in the mixture (column 4, lines 55-59).

Because Arleo illustrates inert gases in etching mixtures are known, absent unexpected results, it would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Shibata by selecting any of the known inert gases in the Arleo reference for the purpose of diluting fluorine-containing gases to aid in etching an insulation layer that would result in improving the formation of via to be substantially without a taper (see Arleo, column 4, lines 62-64).

Claim Rejections - 35 USC § 103

Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Shibata (US '757 A1) as applied to claims 1, 3, 5, 6, 8, 17, and 20 above, and further in view of Liu et al. (US 6,403,491 B1).

Shibata differs in failing to teach the perfluorocarbon is hexafluoro-1,3-butadiene.

Liu teaches etching a dielectric layer using hexafluoro-1,3-butadiene (claims 1 and 24) and illustrates the said perfluorocarbon is known.

Absent unexpected results, it would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Shibata by employing Liu's hexafluoro-1, 3-butadiene because such a fluorocarbon compound is known to be included in etching gases for the purpose making via, self aligned contacts, dual damascene, and other dielectric etch (Liu, Abstract).

Claim Rejections - 35 USC § 103

Claims 9 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shibata (US '757 A1) as applied to claims 1, 3, 5, 6, 8, 17, and 20 above, and further in view of Misra (US 6,242,359 B1).

Shibata differs in failing to teach wherein the fluorocarbon is at least one oxyhydrofluorocarbon, **in claim 9**; and wherein the oxyhydrofluorocarbon is at least one selected from the group consisting of perfluorocyclopentene oxide, hexafluorocyclobutanone, hexafluorodihydrofuran, hexafluorobutadiene epoxide, tetrafluorocyclobutanedione perfluorotetrahydrofuran, hexafluoropropylene oxide, perfluoromethylvinyl ether, and combinations thereof, **in claim 10**.

Misra teaches etching dielectric film with hexafluoropropene oxide (same as applicants' oxyhydrofluorocarbons) compounds (column 3, line 65 – column 4, line 2). Exemplary compounds useful in the etching method include, but are not limited to hexafluoropropene oxide and perfluoromethylvinyl ether or combinations thereof (column 4, line 64 - column 5, line 20).

Because Misra illustrates etching with an oxyhydrofluorocarbon is known, absent unexpected results, it would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Shibata's etchant by using use an oxyhydrofluorocarbon as taught by Misra for the purpose of providing alternative to the conventionally used global-warming compounds for semiconductor etching processes (See Misra, column 4, lines 3-6).

Response to Arguments

Applicants argue on pages 3-5 that the reference of Shibata is incapable of providing motivation to modify the teaching to produce the claimed invention (see top of page 3) because the working examples fail to disclose applicants' specifically claimed mixture (see page 4. lines 17-21) and therefor does not lead one of skill in the art to applicants' claimed mixture (see top of page 5); therefor the reference was found using hindsight (see bottom of page 4).

Examiner disagrees with applicants' assertion that the reference of Shibata is incapable of providing motivation to modify the teaching to produce the claimed invention (see top of page 3) because the working examples fail to disclose applicants' specifically claimed mixture (see page 4. lines 17-21) and therefor does not lead one of skill in the art to applicants' claimed mixture (see top of page 5). The use of hypofluorites (i.e. fluorine containing oxidizers) is well known in the art of plasma etching mixtures because they were discovered as a solution to several well known problems, such as the sole use of reactants that: cause potentially high global warming (i.e. atmospheric pollutants); require high energy required (i.e. high power consumption); and create a byproduct of many un-reacted gas molecules.

The development of such alternative gas, in mixtures, include any hypo-fluorite known to be effective, such as CF_3OF , $\text{CF}_2(\text{OF})_2$, $\text{CF}_3\text{CF}_2\text{OF}$, CH_3COOF , $3\text{C}(\text{CF}_3)\text{OF}$, $\text{CF}_2\text{HCF}_2\text{OF}$, $2(\text{CF}_3 \text{ (CF}_3\text{C F}_2)) \text{ COF}$, CH_3OF , CFH_2OF , CF_2HOF , $\text{CF}_3\text{CF}_2\text{CF}_2\text{OF}$, $2(\text{CF}_3) \text{ CFOF}$, etc. (i.e applicants' specifically claimed species of fluorine containing oxidizer) is known to solve these many problems. It would be

obvious to try a mixture that used any hypo-fluorite, including applicants' specifically claimed fluorine containing oxidizers because the known benefit is perceived as a pressing need for the advancement of the technology (i.e. a critical need). Mori provides evidence that it is known that such chemistry will reduce cost and solve industry problems related to the toxicity of gasses used in etching mixtures. See two Japanese publications by Mori, including paragraph 3 of the Detailed Description section of 2000-063826, and paragraph 5 of the Technical Problem section of 11-236561. It would clearly have been obvious to one of ordinary skill in the art at the time of invention was made, to modify the invention of plasma etching mixture, as Shibata, to include the use of any hypo-fluorite, including applicants' specifically claimed fluorine containing oxidizers, because one of skill in the art would be motivated to try the use of any chemistry that would reduce or eliminate the negative effects known from the use of reactants that: cause potentially high global warming (i.e. atmospheric pollutants); require high energy required (i.e. high power consumption); and create a byproduct of many un-reacted gas molecules as evidenced by the teachings of Mori, to cure a critical need of the industry. Further, absent unexpected results, one of skill in the art would have the ability to use routine experimentation to develop the combination that applicants' claim because Mori provides evidence that such hypo-fluorites would be effective toward solving the critical problems know to industry as recited above.

Examiner disagrees that the reference was found using hindsight, as the claimed invention is a mixture comprising a generic group, fluorocarbon, which widens the search to any (per)fluorocarbon, including one from any list of those known to be

effective, which would include the reference of Shibata. Further, a proper search would include all references to hypofluorites (i.e. applicants' claimed fluorine containing oxidizer, ie. oxygen containing (per)fluorocarbons), in combination with any (per)fluorocarbon, where the reference of Shibata is quickly discovered.

As to applicants' remarks, on page 5-7, toward the surprisingly superior results of applicants' claimed invention, examiner does not find these statements to provide evidence of unexpected results including a showing of how applicant determined the ranges of the claimed chemistry which includes the discovery of the claimed end points.

As applicants only argue obviousness in regard to the reference of Shibata, all other references used in the rejection of 8/21/2007 are considered to be proper.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

NADINE G. NORTON
SUPERVISOR OF EXAMINERS



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Any inquiry concerning this communication or earlier communications from the examiner should be directed to Patricia A. George whose telephone number is (571) 272-5955. The examiner can normally be reached on Mon. - Fri. between 8:00 am and 4:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on (571) 272-1465. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.


PAG
1/08

Patricia A George
Examiner
Art Unit 1792